

## Interlocking Isolator for Fuel Cells

### Introduction

This application claims the benefit of priority from  
5 U.S. Provisional Application Serial No. 60/456,075 filed  
March 19, 2003, which is herein incorporated by reference  
in its entirety.

### Field of the Invention

10 An interlocking isolator for proton exchange  
membrane fuel cells is provided. The isolator provides a  
polymer frame surrounding the flow plates and membrane  
electrode assembly and diffusion layer of the fuel cell.  
This polymer frame isolates the fuel cell from heat and  
15 electricity. The frame further contains a means for  
slidably interlocking an adjacent frame thereto.  
Accordingly, these interlocking isolators are useful in  
creating fuel cell stacks.

### 20 Background of the Invention

Fuel cells are energy conversion devices being  
considered as a possible alternative to internal  
combustion engines. One type of fuel cell comprises a  
solid polymer electrolyte (SPE) membrane, such as a  
25 sulfonated fluorinated polymer membrane material like  
NAFION, which provides ion exchange between the cathode  
and anode electrodes. Various configurations of SPE fuel  
cells as well as methods for their preparation have been  
described. See e.g. U.S. Patent 4,469,579; U.S. Patent  
30 4,826,554; U.S. Patent 5,211,984; U.S. Patent 5,272,017;  
U.S. Patent 5,316,871; U.S. Patent 5,399,184; U.S. Patent  
5,472,799; U.S. Patent 5,474,857; and U.S. Patent  
5,702,755.

SPE fuel cells offer several advantages over liquid electrolyte fuel cells. These include greater power densities, lower operating temperatures, and longer operating lifetimes. In addition, SPE materials are generally resistant to corrosion and easy to incorporate into fuel cell structures. Accordingly, attempts have been made to utilize these various solid polymer electrolyte (SPE) fuel cells as an electronic power source for electric automobiles and space crafts.

However, the need for a catalyst such as platinum in the SPE fuel cells has made these cells more expensive than alternative energy sources.

WO 02/39533 discloses membrane electrode assemblies for use in direct methanol fuel cells comprising a polymer electrolyte membrane with cathode and anode layers having a low content of catalysts with cathode and anode layers on either side of the membrane. In these assemblies, the membrane electrode assemblies are serigraphically printed on an electron conducting substrate such as graphite or carbon paper with an ink comprising catalyst loaded carbon and water dispersed polymer electrolyte membrane material dispersed in a mixture of water, propanol and methanol. Following printing, the anode and cathode layers are boiled in deionized water to remove impurities. The anode and cathode layers and the polymer electrolyte membrane are then placed in a constraint and axially or semi-isostatically compressed, preferably via heat, to form the membrane electrode assemblies.

The present invention provides an interlocking isolator for proton exchange membrane fuel cells such as described above. The interlocking isolator isolates the fuel cell positioned therein from electricity and heat. Further, the interlocking isolator provide a means by which fuel cells can be positioned adjacently to form a

fuel cell stack providing higher desired voltages.

### **Summary of the Invention**

An aspect of the present invention relates to an interlocking isolator for a proton exchange membrane fuel cell. The interlocking isolator comprises a continuous polymer frame rectangular shape and having a top and bottom, four corners and an inner and outer edge. The frame has a lock at its inner edge for positioning of flow plates with a membrane electrode assembly and a diffusion layer of a fuel cell within the frame. The frame also has a means for slidably interlocking an adjacent frame thereto to create a fuel cell stack.

### **Brief Description of the Figures**

Figure 1 provides a diagram of an interlocking isolator of the present invention with a fuel cell positions within the frame of the interlocking isolator.

Figure 2 provides a cross-sectional view of the frame and fuels cell positions within the frame of the interlocking isolator depicted in Figure 1.

Figure 3 provides a diagram of the interlocking isolator of the present invention without a fuel cell positioned within the frame.

### **Detailed Description of the Invention**

The present invention provides an interlocking isolator for a proton exchange membrane fuel cell useful in creating stack of interlocking fuel cells.

As shown in Figures 1-3, the interlocking isolator of the present invention comprises a continuous polymer frame **2**. The frame **2** is preferably rectangular shape for positioning of a proton exchange membrane fuel cell within the frame. As shown in Figure 2, the frame has a top **3**

and bottom **4**. As shown in Figure 1 and 3, the frame also has four corners, **5a-d**, and an inner edge **6** and an outer edge **7**.

As shown in Figure 3, one or more locks **8** are located at the inner edge **6** of the frame **2**. As shown in Figure 1, the lock or locks **8** are used for fixing or positioning two flow plates with a membrane electrode assembly and a diffusion layer of a fuel cell **9** within the frame **1**.

The interlocking isolator of the present invention also comprises a means **10** within the frame **2** for slidably interlocking a second frame located adjacent thereto to the first frame **2**. Further, this means allows for slidably interlocking multiple frames with fuel cells so that a fuel cell stack can be created. In a preferred embodiment, as depicted in Figure 2, this means **10** for slidably interlocking the frame **2** to an adjacent frame to create a fuel cell stack comprises a groove **11** on the top **3** of the outer edge **7** and extending around the rectangular frame **2** and a tongue or tab **12** on the bottom **4** of the outer edge **7** of each corner **5a-d** of the frame **2** sized to slide into the groove **11**.

Thus, the interlocking isolator of the present invention protects the fuel cell from heat and electricity.

The interlocking isolator of the present invention also provides a means for creating stacks of fuel cells wherein a single fuel cell of the stack can be removed simply by sliding the frame in which the fuel cell is positioned from the stack. This fuel cell can then be repaired and reinserted into the stack. Alternatively, the fuel cell can be replaced with a new fuel cell positioned in an interlocking isolator of the present

invention.

Fuel cell stacks produced using these interlocking isolators are useful in coupling the voltage of a series of single fuel cells to obtain a higher total desired voltage level and electromotive force.